AMENDMENTS TO THE SPECIFICATION

Please replace the paragraph that begins on page 2, line 12, with the following amended paragraph:

The most sophisticated phase estimators, ~~that~~ which process simultaneously whole sets of received observations, are based on extremely cumbersome digital processing: particulate filtering, random-walk methods with Markov chain [[etc ...]], etc. In practice, implementing such techniques proves to be unrealizable due to the considerable computing power required.

Please replace the paragraph that begins on page 6, line 25, with the following amended paragraph:

Referring to Fig. 1, a general phase estimation process is described, which is appropriate for any type of modulation, BPSK, 4-QAM [[etc ....]], etc. The process comprises a first step 11 where a set of n+1 observations (Y_0 to Y_n) ~~output~~ outputted from a complex demodulator is received and stored within a block of n+1 observations. Typically, a block of about ~~1000~~ 1,000 to ~~10 000~~ 10,000 observations could be considered, and ~~people~~ persons qualified in the art will choose such number according to the application and the type of modulation considered.

Please replace the paragraph that begins on page 7, line 20, with the following amended paragraph:

In step 14, a second phase locked loop (PLL) executing in opposite direction from the first PLL (as shown in Fig. [[2]] <u>3</u> by [[right-left]] <u>a right-to-left</u> arrow). Preferably, the first value of the second loop, namely φ'_N, is initialized to the last digital value φ_N calculated by the first phase-locked loop.

Please replace the paragraph that begins on page 7, line 25, with the following amended paragraph:

In step 15, the second phase locked loop (PLL) is executed in order to build sequence ~~$\varphi'_{n-1}, \varphi'_{N2}, \varphi'_2, \varphi'_1 \ldots\, \varphi'_0$~~ <u>$\varphi'_{n-1}, \varphi'_{n-2}, \ldots\, \varphi'_2, \varphi'_1, \varphi'_0$</u> calculated in reverse direction compared to previously.

$$\varphi'_k = \varphi'_{k+1} - \gamma F(Y_k, \varphi'_{k+1}) \text{ with } k = n\text{-}1 \text{ to } 0$$

Please replace the paragraph that begins on page 8, line 8, with the following amended paragraph:

Preferably, variable coefficients A_k and B_k could be chosen in order to give more importance to one of the phase-locked loops according to k. Indeed, the ~~«weights»~~ <u>weights</u> of the weighted total can be chosen in order to give more importance to the first loop in the right-hand part of the block of Fig. [[2]] <u>3</u> and, conversely, to add more weight to the second loop in the left-hand part of the block. Thus, the loop having performed the most iterations is always given more importance and will reach a higher degree of accuracy in phase calculation.

Please replace the paragraph that begins on page 9, line 1, with the following amended paragraph:

For phase locked loop initialization, the first value φ_0 is given. Preferably, ~~filter~~ <u>parameter</u> γ will be realized by means of a second-order digital filter, for example a second-order filter according to the following formula:

$$\gamma = \gamma_1 + \gamma_2 / (1 + z^{-1})$$

and it will be initialized while taking into account all usable continuity factors.

Please replace the paragraph that begins on page 9, line 12, with the following amended paragraph:

In step 44, a second Costa's PLL is now initialized to the last value calculated by the first loop and, in step 45 said second loop is executed to build the sequence $\cancel{\varphi'_{n-1}, \varphi'_{N2}, \varphi'_2, \varphi'_1 \ldots. \varphi'_0}$ $\underline{\varphi'_{n-1}, \varphi'_{n-2}, \ldots \varphi'_2, \varphi'_1, \varphi'_0}$ calculated in the opposite direction.

$$\varphi'_k = \varphi'_{k+1} + \gamma \mathrm{Img}(y_k^4 e^{-i4\varphi(k+1)}) \qquad k = n\text{-}1 \ldots 0$$

Please replace the paragraph that begins on page 9, line 32, with the following amended paragraph:

In step 52, the first phase locked loop (PLL) adapted for a BPSK modulation is initialized. In a new and particularly advantageous way, the first PLL is combined with the use of statistical data related to symbols a_k transmitted [[sin]] <u>in</u> this BPSK modulation. To this end, a ~~phase locked loop (PLL)~~ <u>PLL</u> according to the following formula is realized:

$$\cancel{\varphi_K = \varphi_{k-1} + \gamma \mathrm{Img}(y_k e^{-i\varphi(k-1)}\ \mathrm{th}[L_k / 2 + 2 / \sigma^2 \mathrm{Re}(y_k e^{-I\varphi(k-1)}])}$$

$$\underline{\varphi_k = \varphi_{k-1} + \gamma \mathrm{Img}(y_k e^{-i\varphi(k-1)})\ \mathrm{th}[L_k/2 + 2/\sigma^2 \mathrm{Re}(y_k e^{-I\varphi(k-1)})]}$$

where:

th is the hyperbolic tangent operator,
Re is the operator of the real part of a complex number,
σ^2 is the noise variance,
and $L_k = \mathrm{Ln}[p(a_k = 1) / p(a_k = -1)]$,
Ln is the natural logarithm,
$p(a_k = 1)$ is the probability that symbol a_k is equal to +1, and
$p(a_k = -1)$ is the probability that symbol a_k is equal to -1.

Please replace the paragraph that begins on page 10, line 22, with the following amended paragraph:

In step 54, a second phase locked loop (PLL) built like previously is now initialized to the last value calculated by the first loop and, while taking into account statistical data related to symbols. In step 55, this loop is executed to build sequence $\cancel{\varphi'_{n-1}, \varphi'_{n-2}, \varphi'_2, \varphi'_1 \ldots \varphi'_0}$ $\underline{\varphi'_{n-1}, \varphi'_{n-2}, \ldots \varphi'_2, \varphi'_1, \varphi'_0}$ calculated in the opposite direction as compared to previously.

Please replace the paragraph that begins on page 10, line 28, with the following amended paragraph:

Two alternative embodiments are still possible. If noise power stays low, the hyperbolic tangent function can be approximated using a signum function. The following formula is then obtained, which is typical of a decision feedback loop, [[to]] within the term $L_k/2$.

$$\cancel{\varphi_k = \varphi_{k+1} + \gamma \,\mathrm{Img}\,(y_k e^{-i\varphi(k+1)}\ \mathrm{th}[\,L_k / 2 + 2 / \sigma^2\ \mathrm{Re}(y_k e^{-i\varphi(k+1)})\,]\,)}$$

$$\underline{\varphi_k = \varphi_{k+1} + \gamma\mathrm{Img}(y_k e^{-i\varphi(k+1)})\ \mathrm{th}[L_k/2 + 2/\sigma^2\mathrm{Re}(y_k e^{-i\varphi(k+1)})]}$$

Please replace the paragraph that begins on page 11, line 13, with the following amended paragraph:

Both preceding examples show that the process according to the invention applies to any type of modulation and any type of phase locked loop (PLL). Clearly, ~~people~~ persons qualified in the art could readily realize all appropriate adaptations, and even advantageously combine a very early phase locked loop block processing with any subsequent later processing, [[like]] such as error correcting codes, turbo-codes [[etc ...]], etc.